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I, TERESA KOLODZIEJCZYK, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PS 1409 for a patent by LAZER SAFE PTY LTD as filed on 27 March 2002.

WITNESS my hand this
Ninth day of April 2003


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PROVISIONAL SPECIFICATION

Invention Title: **MULTIPLE LASER SAFETY SYSTEM**

The invention is described in the following statement:

MULTIPLE LASER SAFETY SYSTEM

The present invention is generally directed to safety systems used in industrial applications, and in particular to safety systems for use on industrial presses such as a press brake or guillotine. Although the present invention will now be described with respect to press brakes, it is to be appreciated that other applications of the present invention are also envisaged.

The Applicant has developed an industrial press safety system utilising a laser emitting a single continuous planar laser beam having a generally constant lateral width and a light receiver for the laser. Both the laser and the light receiver are mounted on the moveable section of the industrial press. In the case of a press brake, the laser and light receivers are mounted on the moveable tool, and the tool (and laser and light receiver mounted thereon) moves relative to a stationary anvil section. This safety system is described in International Patent Application PCT/AU00/00420, details of which are incorporated herein by reference.

The safety system acts to prevent operators of the press brake from accidentally trapping their hands or other objects between the tool and anvil while operating the press brake. This is achieved by locating the planar laser beam between the tool and the anvil. Any breaking of the laser beam path by an object is detected by the safety system which acts to immediately stop further movement of the tool. The safety system operates in this manner during the movement of a tool towards the anvil until the tool is in close proximity to the anvil. At that time, the safety system must slow the speed of movement of the tool and shut off the laser to allow the tool to complete it's bending operation on a plate or other object located over the anvil. A speed control point is preset by the operator a small distance above the anvil and generally coincides with the top surface of the workpiece on the anvil.

The brake press using a safety system as described above can typically operate using the following operational cycle:

a) If no obstruction is detected during the downward travel of the tool, then the tool moves at high speed (typically about 150 mm/s) towards the anvil. When the laser beam, which is located below the tool, passes the speed control point, the tool slows to a crawl speed (typically about 10 mm/s). The slowing of the tool

speed ensures that there is still sufficient time to withdraw a finger or other object from under the tool at the final approach of the tool to the anvil.

5 b) If an obstruction is detected, the tool will be stopped and reversed a few millimetres so that the tool will not touch the obstruction. The movement of the tool can be continued by the operator using a foot switch. If a further obstruction is detected, then the tool is stopped but not reversed. This enables thicker workpieces to be processed as the operator will allow completion of the cycle by actuating the foot switch to thereby move the tool at crawl speed.

10 The above described operating cycle is the normal mode of operation. Other operational cycles can alternatively be used, for example, a "tray mode" for the production of trays or boxes. This tray mode is described in the above noted International Patent Application and will not be described in detail here.

15 The aim of our device is to protect the operator of the press brake at all times. It is considered that the operator is protected if the press is slowed to 10mm/sec (with tolerance) or if a physical barrier or a light sensing device including our type of system is active. Therefore to provide this continuous protection we slow the press brake to 10mm/sec before we switch off, or desensitise (Mute is a word that is sometimes commonly used) our laser beam or beams.

20 The spacing between the laser beam relative to a leading edge of the tool is generally the distance at which the tool must move in its crawl speed. The spacing of the laser beam can for example be set at about 9.0 mm, and the tool controlled to be able to stop with a distance less than the above noted spacing, for example about 8.5 mm. It would however be advantageous to be able to
25 operate the brake press at higher speeds to reduce production times. To this end, it is envisaged that the high speed of the travel of the tool be increased to about 200 to 220 mm/s as compared with 150 mm/s of current press brakes. This however makes it more difficult to use the above described safety system because the laser beam would need to be located further away from the tool to
30 provide for an acceptable stopping distance for the tool. This however results in the crawl speed of the tool being activated earlier when the laser reaches the speed control point thereby lengthening the time when the tool is moving at the

crawl speed. This at least reduces the benefit achieved in faster production lines due to the higher tool travel speed.

It is therefore an object of the present invention to provide an improved safety system for an industrial press that allows the press to operate at higher speeds thereby facilitating shorter production times.

It is another object of the present invention to provide an improved means of operating a safety system for an industrial press to thereby allow for the press to operate at higher speeds.

With this in mind, according to one aspect of the present invention, there is provided a safety system for an industrial press having a moveable section, the safety system including:

a laser device for emitting a plurality of continuous planar laser beams having a generally constant lateral width;

a light receiver for receiving the planar laser beams and for detecting when an object intersects at least one of the planar laser beams; and

a controller for stopping or preventing motion of the moveable section when the receiving means detects that at least one of the planar laser beam has intersected an object.

The laser device and the light receiver may be similar in construction to those described in the above noted International patent application. The laser device according to the present invention may however emit a plurality of said continuous planar laser beams, the laser beams being position at least generally parallel relative to each other. The use of a single laser device to emit the laser beams facilitates correct alignment of the laser beams relative to each other. To this end, the laser device may include a plurality of laser emitters for respectively emitting a laser beam, and a lens assembly for respectively converting each said laser beam emitted from a said laser emitter to a said continuous planar laser beam. The lens assembly may include a cylindrical prism for initially expanding the or each laser beam into a planar fan shaped laser beam, and a converging lens for refocussing the fan shaped laser beam to a planar laser beam having a generally constant lateral width. The same lens assembly may be used to convert each laser beam to facilitate the correct alignment of the final planar laser beams. It is however also envisaged that a series of laser devices be used to

provide the continuous planar laser beams. The use of planar laser beams provides a greater area of protection for the operator the laser beams preferably extending laterally beyond opposing sides of the moveable section. The laser beams when intersected by an object are also visible to the operator.

5 A single said light receiver may be used to receive the laser beams. The light receiver may include an array of light receiving elements, the elements being aligned along a common axis and located at an end of a receiver body of the light receiver. A cylindrical lens may be provided to focus the laser beam onto the light receiver array. This arrangement facilitates detection of the laser beams even
10 when the industrial press is producing vibration within the safety system.

 A single light receiver may be used to detect the plurality of planar laser beams. These laser beams may be multiplexed such that each laser beam is sequentially turned off and on so that the light receiver only detects one of said laser beams at any one time. It is however also to be appreciated that separate
15 light receivers may be utilised for each said laser beam so that multiplexing is not necessary. Issues of alignment can be greater if more than one laser device and/or light receiver are used. Alternatively, a single light receiver having a plurality of cylindrical lens, each focussing a separate laser beam onto the light receiver array.

20 The industrial press may further include a stationary section, and the laser beams may be located between the moveable and stationary sections of the industrial press. The moveable section may include a leading edge, and each laser beam may be spaced at a different distance to the leading edge. Preferably, two said planar laser beams are emitted by the laser emitting means,
25 with a first said planar laser beam being spaced further from the leading edge than a second said planar laser beam.

 The safety system may define a speed control point close to the stationary section. When the moveable section initially approaches the stationary section, the moveable section may be initially moving at a relatively high speed. When
30 the first planar laser beam reaches the speed control point, the moveable section may begin decelerating. That first planar beam is shut off as it reaches the speed control point. As the moveable section continues to move towards the stationary section, the second planar laser beam reaches the speed control point and the

moveable section may now be moving at a final crawl speed. The second planar laser beam is then shut off. There may be a progressive reduction from the initial high speed to the final crawl speed. This provides a smoother transition in the change in speed of the moveable section when compared with the Applicant's earlier system where there is a step change in the tool speed to the crawl speed. The moveable section may continue to move at the final crawl speed towards the stationary section after the second laser beam has reached the speed control point. The final crawl speed may typically be about 25 mm/s which is higher than the crawl speed of known systems.

In one example arrangement, the first planar laser beam can be spaced about 14mm from the leading edge of the moveable section, and the second laser beam can be spaced about 4mm from the leading edge.

Because the first laser beam can be spaced further from the leading edge than the earlier safety system (typically 9.0mm), a greater stopping distance can be provided. The speed of the moveable section can progressively decrease when the first laser beam reaches the speed control point so that the speed of the moveable section is not suddenly slowed. The speed of the moveable section may be typically about 40 to 50% of the initial high speed by the time the point between the first and second planar laser beam reaches the speed control point.

When the second planar laser beam finally reaches the speed control point, the spacing between the moveable and the stationary section is preferably 6mm or less and the moveable section may be moving at about 25 mm/s. When the moveable section is moving at this speed, it can still stop in less than 4mm if the second planar laser beam is interrupted. The moveable section can at this point continue to move at the constant speed of 25 mm/s. Alternatively, the moveable section can continue to decelerate from 25 mm/s to 10 mm/s and then continue to move at this final speed. There is no need to further slow the moveable section because Industry Standards do not require the moveable section to be slowed when the spacing is 6mm or less, this space being considered too narrow to allow any object to be trapped therebetween.

According to another object of the present invention, there is provided a method of operating a safety system for an industrial press having a moveable section and a stationary section, the safety system providing a plurality of

continuous planar laser beams having a generally constant lateral width, each laser beam being spaced at varying distances from the moveable section, the method including moving the moveable section towards the stationary section at a relatively high speed;

5 starting deceleration of the moveable section when one said laser beam reaches a speed control point located immediately adjacent the stationary section,

moving the moveable section at a final crawl speed when a second said laser beam reaches the speed control point, the moveable section continuing to
10 move at said final crawl speed towards said stationary section.

The moveable section may progressively decelerate until the final crawl speed is reached for the moveable section.

It will be convenient to further describe the invention by reference to the accompanying drawings which illustrate an example arrangement of the present
15 invention. Other arrangements of the invention are possible, and consequently the particularity of the accompanying drawings is not to be understood to be superceding the generality of the preceding description of the invention.

In the drawings:

Figure 1 is a side schematic view of the laser device and light receiver of
20 the safety system according to the present invention.

Figure 2 is a plan schematic view of the laser device and light receiver of Figure 1; and

Figure 3 is a detailed view of an industrial press tool showing the orientation of the planar laser beams according to the present invention.

25 Referring initially to Figures 1 and 2, the safety system includes a laser device 1 and a light receiver 2. Both the laser device 1 and light receiver 2 are similar in construction to the arrangement shown in the Applicant's International Patent Application No. PCT/AU00/00420 and will not therefore be described in detail herein. The primary difference is that the laser device 1 includes a pair of
30 laser emitters 3, each emitter 3 emitting a single laser beam 6. The laser beam 6 passes through a lens assembly 5 to convert that laser beam into a continuous planar laser beam 7a, 7b. The lens assembly 5 typically includes a cylindrical prism 9 for initially expanding the laser beam 6 into a planar fan shape beam.

This beam is then passed through a converging lens 11 and focussing lens assembly 13 for converting the laser beam into said planar laser beam 7a, 7b. A window 15 is provided in front of the lens assembly, and the planar laser beam 7a, 7b passes through the window 15. This planar laser beam 7a, 7b can typically have a width "a" of about 50mm.

Both of the laser beams 6 emitted by laser emitters 3 pass through the lens assembly 5 such that two separate planar laser beams 7a, 7b are emitted from the laser device 1. The laser beams 7a, 7b extend parallel to each other and laterally forwardly and rearwardly relative to the tool 25 as shown in Figure 3.

The light receiver 2 includes a window 17 through which the laser beams 7a, 7b can pass, a cylindrical lens 19 for focussing the laser beams onto a light receiver array 21. These cylindrical lens 19 ensures that the laser beams 7a, 7b are focussed on the light receiver array 21 even when there is vibration of the safety system during operation of the industrial press.

The laser beams may be multiplexed such that each laser emitter 3 is turned on and off sequentially so that only one laser beam 7a, 7b at any one time is received by the light receiver 2. The light receiver 2 therefore only detects a single laser beam 7a, 7b at any one time. This ensures that any interception of one or both laser beams 7a, 7b can be detected.

Figure 3 shows in more detail the orientation of the planar laser beams 7a, 7b relative to a tool 25 of the moveable section of the industrial press. According to the present invention, the laser device 1 and light receiver 2 are both mounted and moveable together with the moveable section of the industrial press. Therefore, the planar laser beam 7a, 7b can be located at a preset spacing away from a peripheral edge 27 of the tool 25. In one example arrangement, the first planar laser beam 7a can be located approximately 14mm from the tool peripheral edge 27. The second laser beam 7b can be located about 4mm from the tool peripheral edge 27. There is therefore a spacing b of 10mm between the first laser beam 7a and second laser beam 7b.

This arrangement facilitates the use of higher tool speeds for the moveable section of the industrial press. The moveable section can for example move at a downward speed of about 200 – 250mm/s (compared with 150mm/s of current

press brakes). The location of the first laser beam 7a enables a longer stopping distance to be set in the system, for example, 13mm.

During operation of the industrial press, when the first laser beam 7a reaches a speed control point provided a short distance above a stationary section of the industrial press, the moveable section begins to decelerate and the first laser beam 7a is shut off. Therefore, as the tool 25 of the moveable section continues to move downwards, when the speed control point is positioned intermediate the first laser beam 7a and the second laser beam 7b, the speed can be anywhere between 40 to 50% of the initial tool speed.

When the second laser beam 7b reaches the speed control point, the tool 25 has decelerated to a slower speed which becomes the final crawl speed for the tool 25. The final crawl speed can be typically about 25mm/s or may continue to decelerate down from 25 mm/s to a final crawl speed of 10 mm/s. The second laser beam 7b is shut off and the tool 25 continues to move at this speed to complete the working cycle of that tool 25.

The present invention allows for more precise control of the speed of the moveable section, with the blade being initially decelerated and then moved at a final crawl speed. This helps to reduce the overall production cycle of the machine.

Modifications and variations as would be deemed obvious to the person skilled in the art are included within the ambit of the present invention.

DATED this 27th day of March 2002

LAZER SAFE PTY LTD

WATERMARK PATENT & TRADE MARK ATTORNEYS

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77 ST GEORGES TERRACE

PERTH WA 6000

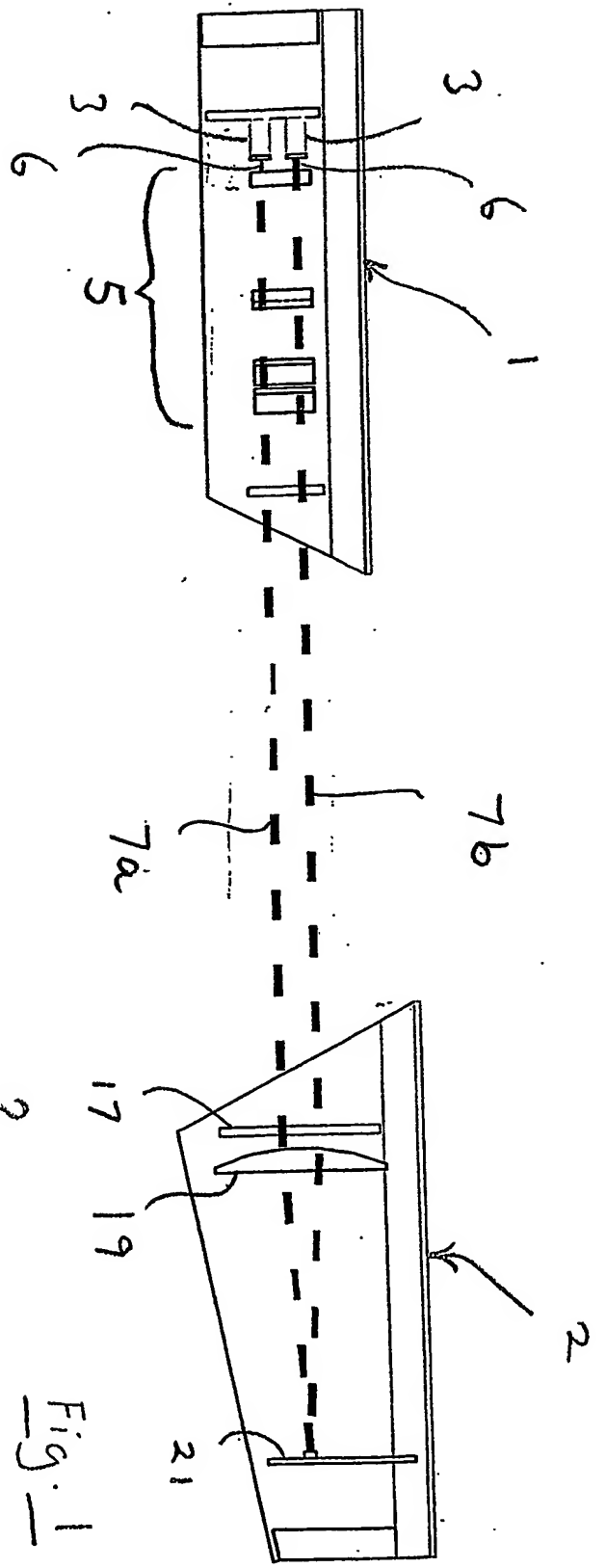


Fig. 1

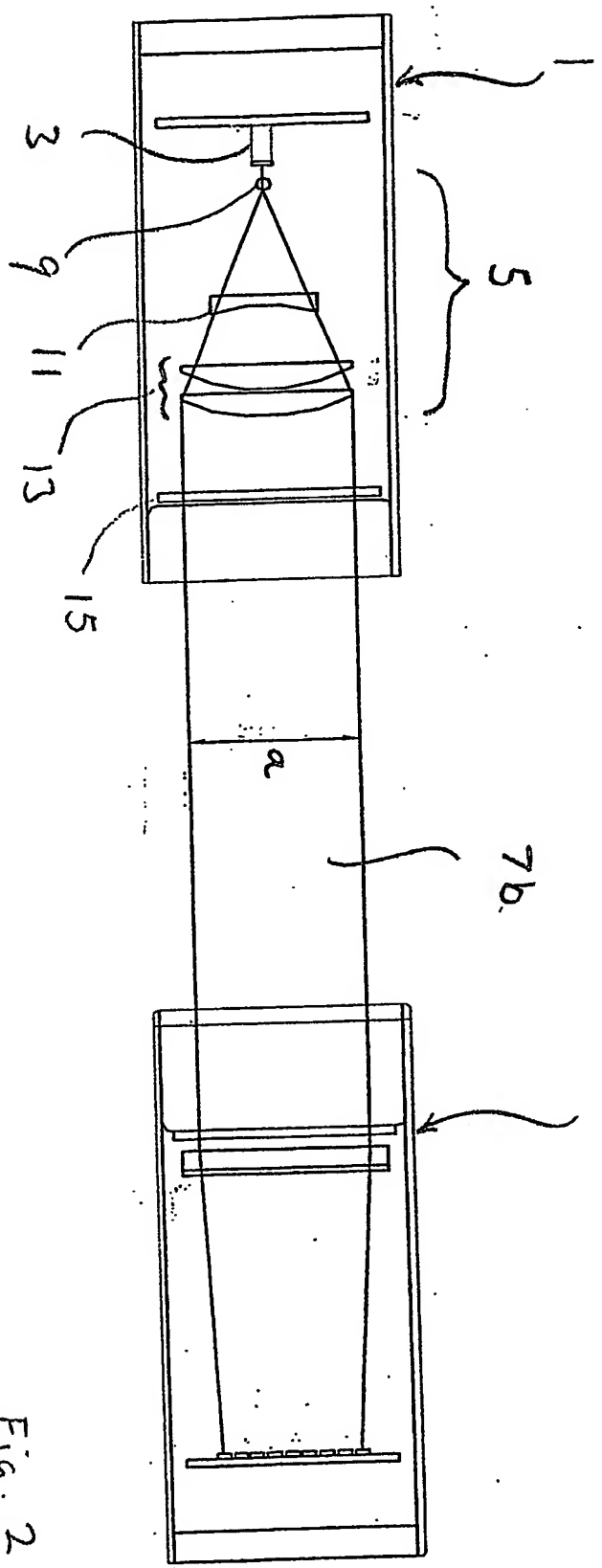


Fig. 2

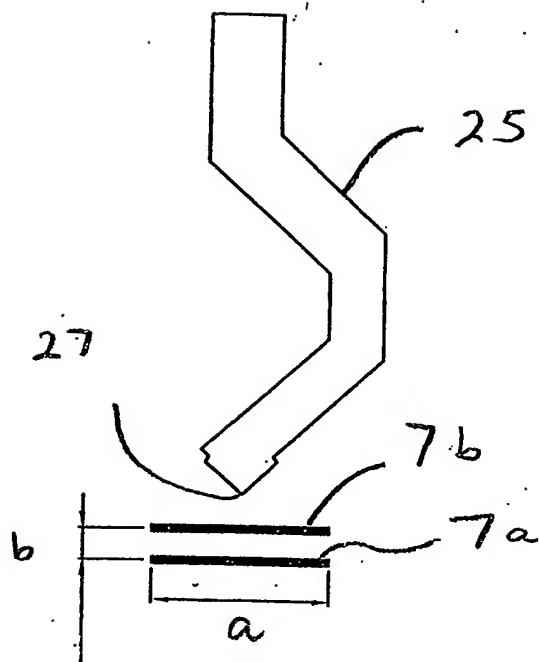


Fig. 3